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ABSTRACT

The evolution of collaborative work relationships among teachers was studied in 13 elementary schools implementing the Wisconsin plan for Individually-Guided Education in a Multi-Unit School. Two hypotheses were entertained: that task interdependence in the teaching of students would (1) raise the level of work-related communication among teachers and (2) increase the scope of joint responsibility for the management of working conditions. These predictions were tested with data collected from individual teachers but aggregated to the level of the formal work "unit" or team. Data collected at four separate times over a period of two years were employed in the analysis. Results supported the prediction of communication but not the prediction of joint responsibility. Although positive cross-sectional correlations were observed between task interdependence and both communication and team management, multiple regression analyses for lagged effects produced only two significant results. During the second year of implementation, the extensity of task interdependence did exhibit positive effects on the extensity and frequency of team communication. However, it is suggested that highly intense task interdependence is characteristic of separate pairs of teachers rather than the larger, formal team, and might even be considered competitive with overall team collegiality. (Author)

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TASK INTERDEPENDENCE, COMMUNICATION, AND TEAM MANAGEMENT AMONG ELEMENTARY SCHOOL TEACHERS

Kenneth Duckworth and Thomas Jovick

MITT PROJECT

CEPM

University of Oregon

1978

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TABLE OF CONTENTS

		Page
I.	Introduction.	1
II.	Measuring the unit.	6
III.	Effects of task interdependence on communication and team management.	13
IV.	Conclusion.	32

LIST OF TABLES

Table 1.	Sample means and standard deviations for measures of task interdependence and classroom communication, for each data collection.	15
Table 2.	Cross-sectional correlations among different measures of task interdependence and classroom communication.	18
Table 3.	Cross-sectional correlations between task interdependence and classroom communication, for each data collection.	19
Table 4.	Regression of classroom communication on task interdependence.	21
Table 5.	Sample means and standard deviations of team management, for each data collection.	25
Table 6.	Cross-sectional correlations between team management and collegial decision-making (school-level indices), for each data collection.	27
Table 7.	Cross-sectional correlations between task interdependence and team management, for each data collection.	29
Table 8.	Regression of team management on task interdependence.	30
Table 9.	Summary display of effects relevant to Hypothesis 1.	33

APPENDICES AND REFERENCES 36

TASK INTERDEPENDENCE, COMMUNICATION, AND TEAM MANAGEMENT AMONG ELEMENTARY SCHOOL TEACHERS

Kenneth Duckworth and Thomas Jovick

1. Introduction

This paper is concerned with the evolution of work relationships among elementary school teachers. For some time, the alleged isolation of such teachers, each in her or his self-contained classroom, has been regarded as a problem by students of the profession and of the organization of public education. Jackson (1968) was ambivalent about the lack of sophistication in teachers' work conceptions, which he attributed to their spending most of their working lives in the exclusive company of children. Lortie (1969) argued that teachers were handicapped in their endeavor to "professionalize" their occupation--and thus improve their working conditions and influence in local settings--by the lack of an articulated and developed code of teaching practice, enforced by collegial evaluation.* Finally, proponents of elaborate, often school-wide, instructional innovations have had to contend with the absence of powerful hierarchical control mechanisms in schools with which their programs could be implemented. "Faculty resistance" to change has proved considerable in some situations (e.g., Gross, Giaquinta, and Bernstein, 1971; Wolcott, 1977), which has reminded students of innovation of the necessity for teacher participation in the planning of change (e.g., Fullan, 1972). Organizational theory concerning the "fit" between various task parameters and coordination structures (Thompson, 1968; Perrow, 1970) however,

*The implicit contrast with doctors and lawyers seems less cogent today, after doubt has been cast on those professions' "self-control."

suggests that not only the problem of change, but also the large element of unpredictability and intuitive response in teaching would indicate the need for a decentralized control system. Hence teacher participation should extend to ongoing management of complex instructional programs by small work groups of teachers. These considerations indicate a need to understand conditions under which teachers develop a more active collegial culture.

The focus of this paper is different from that of other presentations in this symposium*, all of which also originate from the project Management Implications of Team Teaching (MITT) at the University of Oregon. Charters' paper has addressed the problem of changes in teacher influence, autonomy, and job satisfaction deriving from participation in a team-teaching innovation. He has been concerned to distinguish characteristics of a selected group of experimental schools from loosely-matched control schools, but not to delve into differences within the group of experimental schools. Packard and Jovick's paper, on the other hand, has trained its sights on the experimental schools and has sought to identify pre-implementation factors affecting the extent of implementation of the Individually-Guided Education/Multi-Unit School (IGE/MUS) innovation. The present analysis also restricts its attention to the experimental schools and inquires into the course of implementation without respect to prior conditions. Rather, we seek to understand how small work groups of teachers--the "units"--evolve over time, particularly with regard to collegial interaction and management of work.

The thinking behind this analysis has benefited from the work of the Environment for Teaching Project at Stanford (Cohen, et al, 1976). In

*This paper was presented at the Symposium on "Governance and Collaborative Teaching in Elementary Schools" (Session 26.08) at the Annual Meeting of AERA, Toronto, 1978.

particular, Eric Bredo's (1977) analysis of team factors affecting collegial communication and influence has suggested the general framework for the present analysis. This is not intended to be a replication of Bredo's study, however, because not all of Bredo's variables have been measured by the Oregon project. Where there is overlap, furthermore, different indicators often have been employed.* Finally, the present study is aimed at identifying causal relationships evident in a longitudinal data set rather than refining a path model with cross-sectional data.

We will concentrate on the effects of task interdependence on communication and team management. The interpenetration of teachers' work is a prevalent feature of IGE/MUS. Such instructional arrangements produce task interdependence and generate costs in uncertainty and mutual interference among teachers posing contingencies for one another. Organizational theory, developed in March and Simon (1958) and Thompson (1968) predicts that coordination structures will emerge to reduce these costs. At the very simplest, interdependent actors will have to communicate with one another about work problems of mutual concern:

> Hypothesis 1. Teacher communication about work will increase as a function of the level of task interdependence among teachers.

Such communication, of course, is often thought to provide a milieu for professional growth and hence is relevant to the concerns mentioned at the outset

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*For example, we have not measured open space architecture (not a widespread phenomenon in the MITT sample), team policies, team hierarchy, or team collegial influence. Furthermore, our measures of joint teaching, cross-grouping, and communication are different from Bredo's.

of this paper. A second sort of coordination is collegial governance of work conditions. We hope here to shed some light on the puzzling discrepancy noted in Packard and Jovick's paper with respect to the relationship between the instructional and managerial components of IGE/MUS. These two phenomena seemed to come into positive association only during the second year of implementation. During the first year, each seemed to expand at the expense of the other. Whatever may have been true of schoolwide characteristics, this seems improbable in the realm of team (i.e., unit) management of work conditions and team-level task interdependence. Team management is a more direct coordination response to task interdependence than is school-wide collegial decision making in general (which presumably is affected by non-instructional factors such as principal leadership style and community environment). Hence team management, like work-related communication, ought to be affected by the level of task interdependence:

> Hypothesis 2. Team management will increase as a function of the level of task interdependence among team members.

These two hypotheses constitute the structure of the ensuing analysis. It should be noted, however, that nothing has been said about the reverse influence of collegial interaction and governance on task interdependence. In part, this reflects the authors' belief that the re-arrangement of teaching work is sufficiently arduous as not to be predictable simply from teacher interaction and decision-making practices. All the units in this analysis presumably encountered the same stimulus to work re-arrangement in deciding to adopt IGE/MUS. Subsequent fluctuation in task interdependence might be seen as the gradual unfolding or gradual failure of intentions present at

the outset. However, a contingency theory of coordination would benefit from evidence that appropriate coordinative devices are necessary to sustain task interdependent relationships--especially in schools where there are no hard logics of mechanized technology or the marketplace to sustain task interdependence in spite of inappropriate structural conditions (such as might be found in inaptly managed factories). Hence, in the course of testing the main two hypotheses,we shall be alert for evidence of reciprocal effects of communication and team management upon task interdependence.

II. Measuring the Unit

The data base for this paper is the same as reported in Charters (1978) and Packard and Jovick (1978): individual teachers' responses to a variety of instruments administered by the MITT Project at five different times--"waves"--over three school years. Selection of schools and general data collection techniques have been described elsewhere (Packard, et al, 1976). For the analysis of relationships over time between task interdependence and communication and team management, however, these responses are aggregated to the level of the formal work unit created in the schools implementing IGE/MUS. The unit was chosen rather than the school because the great majority of task-interdependent relationships occurred within rather than across unit membership lines. The unit was chosen rather than the individual teacher or teacher pair because unit structure had greater stability across the time period studied than did internal membership and liaisons. There was considerable turnover of personnel from year to year and considerable shifting of pairwise relationships. We adopted the heuristic assumption that the unit provided a vehicle for continuity in teacher collaboration.

Focusing on the unit limits the analysis to the 16 "experimental" schools; there was no analogous substructure in the control schools. Furthermore, we had to exclude T1 data (pre-implementation spring) from the analysis, because units were not in existence at that time.

In addition to these limitations, three of the 16 schools became ineligible for consideration in an analysis of the data from T2 to T5 because two of them dissolved the unit structure during the second year of implementation

and the third failed to turn in task interdependence data. Hence the sample is reduced to 13 schools measured on the following schedule:

First Year of Implementation		Second Year of Implementation	
Fall 1974	Spring 1975	Fall 1975	Spring 1976
T2	T3	T4	T5

These 13 schools comprised a total of 55 units*, varying widely in size and grade responsibility.

Before describing specific measures and analyses conducted, let us itemize possible outcomes of testing each of the two hypotheses presented earlier with four waves of data:

(a) one might find no relationships, either within or across waves, leading to a rejection of the hypotheses;

(b) one might find relationships within wave but not across waves. Depending on the strength, consistency, and pattern of these relationships, the hypotheses might not be disconfirmed. It could be surmised that variables were so responsive to each other as to produce effects virtually immediately, rather than require a six-month (or more) period to generate lagged effects. However, there would be no warrant for inferring direction of causality.

(c) one might find the lagged effects predicted, confirming the hypotheses

*The number of units is reduced from 55 to 53 during the second year, because one school consolidated some of its units. Although there are 2 fewer units, one of the consolidated units is an exact combination of two earlier units; in longitudinal analyses, it is treated as the later counterpart of each of those two units, producing an N of 54 rather than 53.

and indicating that cross-sectional relationships should be interpreted as the effect of task interdependence on communication and team management.

(d) finally, one might find lagged effects from the "dependent" variable on the "independent" variable instead of or in addition to the predicted effects. This possibility is one not usually entertained deliberately, yet not to consider such effects with the data available would be to over-simplify and possibly distort the real relationships among the variables under consideration.

We will proceed by investigating each of these possibilities in turn with the variables designated by each of the two hypotheses. Emphasis will be on testing the impact of task interdependence on communication and management (outcome "c"), however, in line with the hypotheses offered.

Measurement of Task Interdependence. Elementary school teachers' work consists largely of providing instruction to specific students in a range of subjects. The staff of the MITT Project decided to focus on the instruction of students in common as the "bottom line" of task interdependence. If one's own students receive instruction from another teacher, that teacher poses contingencies for one's own work. At the simplest, one must schedule the pattern of student exchanges. Hence we have constructed an index of scheduling interdepence.* Beyond the problems of time and space of instruction, however,

*This differs from "throughput interdependence", elsewhere described in MITT reports, in that throughput interdependence is limited to teachers who divide subject-matter responsibilities to some degree, whereas "scheduling interdependence" refers to all instances of student exchange.

it is also possible that one's teaching may depend upon what (as well as where and when it happens) the other teacher does with the shared students. This is much more likely to occur when both teachers are instructing common students in one or more common subjects. One cannot begin a new lesson without finding out what the other teacher covered and how well the student did. This involves a higher level of interdependence, which we call instructional interdependence. We treat instructional interdependence as a special case of scheduling interdependence.

As is described elsewhere (Packard, et al, 1976), teachers kept instructional logs for a two-week period at each data collection time. From these logs, we were able to identify reciprocally-documented pairs of teachers with scheduling interdependence bonds and, among these, those with instructional interdependence bonds. With this information, we computed a score for each unit reflecting the number of intra-unit pairs (we ignored the few cross-unit pairs) as a proportion of the number of possible pairs in the unit, given the number of logs returned. Two scores were assigned to each unit for each wave:

$$\text{Diffusion of Scheduling Interdependence} = \frac{\text{Number of pairs with scheduling interdependence}}{\frac{n(n-1)}{2}}$$

$$\text{Diffusion of Instructional Interdependence} = \frac{\text{Number of pairs with instructional interdependence}}{\frac{n(n-1)}{2}}$$

where n = number of logs returned by unit members in each data collection. We chose this ratio rather than the simple number of pairs because units varied in size from two to eight persons (although 3- or 4-person units consti-

tuted from 69% to 80% of the sample, depending on the wave) and a single interdependent pair has different significance in a 3-person unit than in a 6-person unit. These scores ranged from "0," indicating no interdependence, to "1," indicating that the unit was completely interconnected with interdependence bonds.

In addition to these measures of the relative extensity of task interdependence in each unit, it was possible to obtain an additional piece of information about each unit concerning the ambitiousness or intensity of the instructional interdependence occuring. For each unit, we computed the average frequency with which teachers in instructionally-interdependent pairs posed contingencies for each other. At the teacher-pair level, this score had a low value of "1," indicating that a teacher instructed the common students only once and in only one subject during the two-week period logged. The high value was "50," indicating that a teacher instructed the common students in five subjects every day.*

The formula for the unit index was as follows:

$$\text{Intensity of Instructional Interdependence} = \frac{\text{Sum of frequency scores for each pair}}{\text{Number of instructionally-interdependent pairs}}$$

It should be noted that this score does not "describe" the unit as a whole as do the diffusion scores but rather characterizes the phenomenon occurring within the unit. It is computed only for units with some instructional interdependence which, it will be seen, is less than half the total number of units.

*Details of the scoring of teacher pairs are given in Packard, et al, (1976), appendix A.

Measurement of Communication. For each unit, we wanted to know how widespread communication was and how frequently it occurred. Teachers responded in each data collection to a question about their communication with other teachers in the school concerning classroom matters--to be called "classroom communication" hereafter.* From this data, we counted the number of reciprocally-nominated pairs of teachers communicating in each unit, which we term diffusion of classroom communication in the unit. The formula is:

$$\text{Diffusion of Classroom Communication} = \frac{\text{Number of pairs in communication}}{\frac{n(n-1)}{2}}$$

where n = number of valid questionnaire responses in each unit.

This score ranges from "0" to "1", like diffusion of task interdependence scores.

In addition, the average frequency of communication was computed from teacher pair scores assigned values of "1" (weekly or less), "2" (semi-weekly), or "5" (daily). Again, as with intensity of instructional interdependence, this is computed over communicating pairs only (although, in this case, all units had some classroom communication).

$$\text{Frequency of Classroom Communication} = \frac{\text{Sum of frequency of scores for each pair}}{\text{Number of pairs in communication}}$$

Measurement of Team Management. Whereas the above variables are measured with indices derived from the same basic data as school-level indices of task

*Also obtained was information about their communication concerning schoolwide affairs and non-work concerns. We limit our analysis to communication about classroom matters in order to minimize school-level and friendship effects.

interdependence and communication discussed in Charters' and Packard and Jovick's papers, the "collegial decision-making" score described in Packard and Jovick was based on data not amenable to distinctions among units in the same school. For our governance variable--team management--we therefore employ teachers' responses to a different item on the questionnaire.

Teachers were given a list of five school management functions: supervising aides, supervising new teachers, scheduling special-subject teachers, grouping students for instruction, and determining teaching schedules. They were asked where the responsibility for each function lay--with the principal, a committee, unit leaders, the unit as a whole, or individual teachers. For each teacher, the proportion of functions was computed for which the unit as a whole was indicated as responsible. This proportion was averaged over all members of the unit to provide a measure of joint management responsibility. This score could vary from "0" to "1", i.e., from no functions exercised jointly to all functions exercised jointly.

Summary. We are now equipped with four measurements, at six-month intervals, of unit-specific values on each of the variables designated by the hypotheses. The following list displays this situation.

Variables	Indices
Task Interdependence	Diffusion of Scheduling Interdependence Diffusion of Instructional Interdependence Intensity of Instructional Interdependence
Communication	Diffusion of Classroom Communication Frequency of Classroom Communication
Team Management	Joint Management Responsibility

III. Effects of Task Interdependence on Communication and Team Management

A. Task Interdependence and Communication. The first hypothesis predicted that the level of work-related communication in a unit would be a positive function of the level of task interdependence. This hypothesis was tested with the three measures of interdependence and two measures of classroom communication described above. Before presenting the results of that analysis, however, we will provide a statistical profile of these variables as measured.

Table 1 shows the means and standard deviations for the five measures at each of the four data collection times. The data show that scheduling interdependence was considerably more diffused throughout units than was instructional interdependence. Moreover, scheduling interdependence became more prevalent in the second year of implementation--e.g., $\bar{x} = .61$ at T4 vs. $\bar{x} = .54$ at T2--whereas instructional interdependence showed no increase and perhaps declined a bit from the first to the second year.* Yet, if instructional interdependence did not spread, it did become, on the average, more ambitious. The sample mean of intensity of instructional interdependence exhibits a constant (if modest) increase from wave to wave. One may speculate from this evidence that although units tended to opt for cross-subject student exchange vs. same-subject student exchange, those units sustaining same-subject student exchange did intensify such arrangements over time.

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*Appendix A shows the distribution of unit scores on each of the diffusion measures. By T5, almost half of the units were completely interconnected with scheduling interdependence bonds, whereas more than half had no instructional interdependence bonds.

----------[1]
Table 1 About Here

The wave-to-wave autocorrelations for each measure are displayed in Appendix B.* In general, scheduling interdependence exhibited the most auto-predictability from wave to wave, especially within each year (T2 to T3, T4 to T5). Regarding instructional interdependence, diffusion was modestly predictable from one wave t another, whereas intensity was predictable only within year, suggesting a higher vulnerability to unit membership turnover and specific pairings.

The data on communication, which Hypothesis 1 predicts should display the effects of task interdependence, exhibit even less sample-wide change from wave to wave than interdependence scores. As the figures in Table 1 indicate, the diffusion of classroom communication is nearly total from the outset (e.g., $\bar{x}$ = .91 at T2) and shows no appreciable change from wave to wave.** Evidently most communication channels in units are in use, although such use may be infrequent (i.e., less than weekly).*** The measure of the frequency of classroom communication, on the other hand, does show an increase

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*It should be noted that the measures of both diffusion and intensity of instructional interdependence were strongly skewed in a positive direction. A log transformation has been applied to each of these variables before including them in multivariate analyses in order to reduce the violence done to assumptions of normality of distribution.

**We must accordingly adopt a different perspective on this variable than the one given to diffusion of task interdependence. With communication, it is the absence of bonds that is noteworthy, whereas with task interdependence, we remark the presence of bonds. Perhaps collegial interaction is rather common, and problems arise from its lapse.

***Appendix A shows the distribution of unit responses. The percentage of units completely interconnected with classroom communication bonds declines from 74% at T2 to 64% at T5, despite the stability of the mean.

[1]Table 1 appears on p. 15.

Table 1: Sample Means and Standard Deviations of Measures of Task Interdependence and Classroom Communication, for Each Data Collection.

N=55 except as noted.

		T2	T3	T4	T5
Task Interdependence					
Diffusion of Scheduling Interdependence	$\bar{X}$	.54	.54	.61	.63
	S.D.	.42	.42	.41	.40
Diffusion of Instructional Interdependence	$\bar{X}$	.24	.22	.18	.20
	S.D.	.33	.31	.28	.32
Intensity of Instructional Interdependence (N=26)	$\bar{X}$	8.14	10.28	12.23	12.82
	S.D.	8.45	8.49	11.82	11.43
Classroom Communication					
Diffusion of Communication	$\bar{X}$	.91	.88	.89	.90
	S.D.	.18	.21	.19	.16
Frequency of Communication	$\bar{X}$	3.47	3.67	3.75	3.68
	S.D.	1.34	1.21	1.29	1.24

from T2 to T4, although T3 and T5 measures are nearly identical and somewhat below the T4 figures. Evidently, fall of the second year is the highpoint. The mean values indicate that the average frequency of teacher-teacher communication is about halfway between semi-weekly (2) and daily (5).

Auto-correlational data for communication measures are presented in Appendix B.* The frequency of classroom communication is highly predictable from wave to wave, especially within year (like scheduling interdependence). Diffusion of communication, however, becomes unpredictable in the second year, especially from T4 to T5. Evidently something else is affecting T5 scores. We might expect task interdependence effects to show up here if anywhere; otherwise, such instability in the diffusion of communication score might indicate unreliability in the measure.

With multiple measures of both task interdependence and classroom communication, the question naturally arises whether the measures are tapping the same phenomenon. As Table 2 shows, the two diffusion measures of task interdependence are moderately correlated. Given that all instructionally-interdependent pairs are also scored as interdependent with regard to scheduling, the correlation is rather weak. Evidently the forces which produce instructional interdependence are distinct from those producing scheduling interdependence. (The latter is perhaps less particular to the

*The diffusion of classroom communication, as might be surmised from such a high mean, is strongly skewed in a negative direction. Here also a log transformation has been applied for multivariate analyses.

IGE/MUS innovation.) More surprising is that there is a negative relationship between the diffusion and intensity of instructional interdependence. Widespread instructional interdependence is apparently characterized by many pairs with infrequent student exchange, whereas highly-interdependent teacher pairs tend to function in units without extensive interdependence. This is an interesting anomaly in the data and will be kept in mind while interpreting the effects of task interdependence on other variables. The two measures of communication, finally, are weakly related during the first year but not thereafter. Evidently something acts to disturb this relationship in the second year.

---------- [2]
Table 2 About Here

The first step in testing the hypothesized effect of task interdependence on communication is to inspect the cross-sectional relationships between the variables. Table 3 displays the Pearson correlation coefficients relevant to this purpose.

---------- [3]
Table 3 About Here

The coefficients show that scheduling interdependence is more consistently related to communication than is instructional interdependence. The diffusion of scheduling interdependence is positively associated with the diffusion of classroom communication in the second year (T4 and T5) and with the frequency of classroom communiction at T2 as well. In contrast, the diffusion of instructional interdependence is positively associated with communication (both frequency and diffusion) only at T4.

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[2] Table 2 appears on p. 18

[3] Table 3 appears on p. 19

Table 2. Cross-sectional Correlations Among Different Measures of Task Interdependence and Classroom Communication.

N=55 except where noted.

Task Interdependence	T2	T3	T4	T5
Diffusion of Scheduling Interdependence:				
x Diffusion of Instructional Interdependence	.49***	.42***	.34**	.28*
x Intensity of Instructional Interdependence (N=26)	-.31	-.06	-.18	-.36*
Diffusion of Instructional Interdependence:				
x Intensity of Instructional Interdependence (N=26)	-.37*	-.18	-.10	-.22
Classroom Communication				
Diffusion of Communication:				
x Frequency of Communication	.39***	.24*	.20	.15

Significance key: * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

Table 3. Cross-sectional Correlations between Task Interdependence and Classroom Communication, for Each Data Collection.

N=55 except where noted.

	T2	T3	T4	T5
Diffusion of Scheduling Interdependence:				
x Diffusion of Communication	.12	.08	.29*	.41***
x Frequency of Communication	.36**	.20	.52***	.47***
Diffusion of Instructional Interdependence:				
x Diffusion of Communication	.12	.17	.28*	.13
x Frequency of Communication	.16	-.03	.31**	.04
Intensity of Instructional Interdependence (N=26):				
x Diffusion of Communication	.05	-.10	.14	-.07
x Frequency of Communication	.29	.53***	.24	.20

Significance key: * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

The relationship between intensity of instructional interdependence and communication appears to be the weakest of all. There is no relationship to diffusion of communication and a (positive) relationship to frequency of communication only at T3 (the size of that coefficient is deceptive; with the number of units reduced to 26, higher coefficients are to be expected--the significance level is only $p \leq .01$).

With cross-sectional results, one is not usually justified in inferring causality. One can merely say that two phenomena can be expected to co-vary in strength. In this case, one might want to limit interpretation to the statement that, by the second year of implementation, units with more diffuse scheduling interdependence are likely to exhibit more inclusive classroom communication networks and to use these networks more frequently than are units with less diffuse scheduling interdependence. The next step is to employ the opportunity of longitudinal data to detect lagged effects of one variable measured at an earlier time on another measured at a later time. The technique used is multiple regression, with the dependent variable regressed first on its earlier value and then on the earlier value of the independent variable. This technique was applied to all possible wave-to-wave combinations of measures of task interdependence and communication, although primary attention was given to the more-easily-interpretable within-year effects (e.g., T2 to T3). Table 4 reports the few lagged effects which were discovered. Inasmuch as these effects are positive, they support the hypothesis that communication increases in response to task interdependence.

Table 4 About Here

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[4]Table 4 appears on page 21.

Table 4. Regression of Classroom Communication on Task Interdependence.

Criterion	Time	Predictor	Time	Beta	Cumulative R^2	F	df
Diffusion of Communication	T5	Diffusion of Communication	T4	-.07	.00	0.00	1/51
		Diffusion of Scheduling Interdependence	T4	.46	.20	12.50**	1/50
Diffusion of Communication	T5	Diffusion of Communication	T4	.08	.07	1.73	1/23
		Diffusion of Scheduling Interdependence	T4	.47	.31	7.65*	1/22
		Intensity of Instructional Interdependence	T4	-.28	.38	2.37	1/21
Frequency of Communication	T5	Frequency of Communication	T4	.56	.47	45.23**	1/51
		Diffusion of Scheduling Interdependence	T4	.24	.51	4.08*	1/50

Significance key: * $p \leq .05$; ** $p \leq .01$

As one can see, the lagged effects are on T5 communication variables. (It will be remembered that these were not significantly correlated with each other.*) Apparently, the level of diffusion of scheduling interdependence at the beginning of the second (T4) does lead to increases in both the diffusion and frequency of communication by the end of that year (T5). There are no separate effects on communication of diffusion of instructional interdependence; once scheduling interdependence has been added to the prediction equation, added effects of instructional interdependence are insignificant. The same is true of intensity of instructional interdependence, although here the added effect is negative; because of its interest, and because the low N (26) may be masking its significance, this finding also has been included in Table 4. It is possible that the more ambitious the instructional interdependence (of a subset of the unit) the more likely that some communication channels fall into disuse from T4 to T5. This is a tantalizing hint that really intense task interdependence may not only be limited to pairs of teachers within a unit (the real instructional "team") but also may weaken the cohesiveness of the unit as a whole. Perhaps some units are too big for the instructional collaboration intended for them.**

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*Tabulation is limited to the effects of T4 on T5; although earlier measures of the independent variable also produced lagged effects on the dependent variables at T5, it seems likely those effects are spurious and due to the strong wave-to-wave autocorrelations of the independent variable.

**The relationship of unit size to these variables is a complex one and will be taken up in a forthcoming report. Preliminary checks failed to support a suspicion that variable relationships discussed in this paper are spurious by-products of size effects on both independent and dependent variables.

In general, then, the first hypothesis may be considered to have received weak support. Only T4-to-T5 effects are statistically significant and only scheduling interdependence appears to play a causal role. Regarding the lack of effects during the first year, the authors subscribe to the interpretation that first year efforts were fairly turbulent with little coherence. A lot of communication then was generated by trial and error; not until the second year did the innovation assume a stable format allowing the effects hypothesized here to emerge.

Efforts were made to detect evidence of reverse causal effects--i.e., of communication upon interdependence--without substantial success. Only one regression proved significant--that of T4 diffusion of communication on T5 scheduling interdependence. The effect, a negative one, was statistically significant, but explained only 1% of variance over and above the 90% already explained by the autoregression term. In this light, it is hard to take this effect too seriously. Otherwise, there is no evidence that communication affects task interdependence.

B. Task Interdependence and Team Management

The second hypothesis predicted that team management would develop in direct proportion to the level of task interdependence in units. Testing this hypothesis followed the same procedures as the first hypothesis, beginning with an examination of the dependent variable, joint management responsibility. This measure has been described earlier as the proportion of five functions of team members described as exercised by the unit members jointly. Table 5 shows the mean and standard deviation for this measure at each of the four data collection times. Joint management responsibility appears to increase from T2 to T3 only to drop back to slightly below the T2 mark at T4 and T5. The mean's value indicates that the average unit exercised only one function out of the five (and in fact the modal response was one at T2, two at T3, and zero at T4 and T5).*

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Table 5 About Here

Joint management responsibility was least predictable from T2 to T3 but thereafter became a fairly stable characteristic of units (see Appendix B for autocorrelations). The T2-T3 autocorrelation was only .32, the lowest correlation for that time interval of all the variables under consideration, suggesting that a subset of the sample of units may have been responsible for the increase at T3.

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*The distribution of unit scores at each wave is shown in Appendix A. The data further suggest that "grouping students for instruction" was the function most often assumed by the unit, with "determining teaching schedules" and "supervising the work of aides" the two other functions chosen frequently. Hardly any units supervised new teachers or set the schedule of special-subject teachers--these functions presumably were exercised by the principal.

[5]Table 5 appears on page 25 .

Table 5. Sample Means and Standard Deviations of Team Management, for each Data Collection.

(N=55)

		T2	T3	T4	T5
Joint Management Responsibility	$\bar{X}$	.26	.32	.24	.25
	S.D.	.16	.17	.17	.17

As mentioned, the joint management responsibility measure is based on different data than the school-level indices of collegial decision-making employed by Packard and Jovick. Hence we deem it necessary to establish the validity of this measure in comparison with those school-level indices. We would expect joint management responsibility to be sensitive to school differences in collegial decision-making. Table 6 treats the school-level indices as contextual attributes of each unit and shows a respectable level of association, except at T_2.

Table 6 About Here [6]

Furthermore, the relationship is stronger with "area 2" decisions, which referred to management decisions similar to the item included in the joint management responsibility question, than with "area 1" decisions, which referred more to intra-classroom instructional decisions. School scores on collegial decision-making, however, exhibited no decline from T3 to T4 comparable to the decline in joint management responsibility, which suggests that school-wide collegial governance may be a more enduring phenomenon than team management.

The cross-sectional relationships of measures of task interdependence to joint management responsibility are shown in Table 7. Given the kinds of functions included in the management question, one might have expected the relationship with scheduling interdependence to be the strongest, but in fact, this becomes significant only at T5. On the other hand, the diffusion of instructional interdependence is consistently related positively (if weakly)

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[6] Table 6 appears on page 27.

Table 6. Cross-sectional Correlations between Team Management and Collegial Decision-Making (School-Level Indices), for Each Data Collection. N=55

Joint Management Responsibility	T2	T3	T4	T5
x Collegial Decision-Making (Composite Index)	.08	.53***	.65***	.54***
x "Area I" Collegial Decision-Making (Intra-Classroom)	.00	.46***	.35**	.31**
x "Area II" Collegial Decision-Making (Management)	.11	.47***	.62***	.53***

Significance key: * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

to joint management responsibility, although the T5 coefficient is here the one lapse in statistical significance. Finally, the intensity of instructional interdependence appears to have no positive relationship (rather a suggestion of a negative one at T4) to team management. This last adds another detail to the picture of the divergence of ambitious instructional collaboration from unit-wide cohesiveness.

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Table 7 About Here

Moving from cross-sectional to longitudinal analysis, we regressed joint management responsibility on each of the three measures of task interdependence for all possible wave combinations. There were no statistically significant effects. Hence, the hypothesis was not confirmed by the data. However, there were a few interesting relationships which almost reached statistical significance, and these are shown in Table 8. It appears that instructional interdependence at T2 may have an impact on joint management responsibility at T4--i.e. from the beginning of the first year to the beginning of the second year. The two measures of instructional interdependence, however, have opposite impacts: the diffusion of instructional interdependence has a positive beta, whereas the intensity of instructional interdependence has a negative beta.*

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Table 8 About Here
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*There is also a negative beta from T2 intensity of instructional interdependence to T5 joint management responsibility, for which the R^2 increment is also not significant.

[7]Table 7 appears on page 29.

[8]Table 8 appears on page 30.

Table 7. Cross-sectional Correlations Between Task Interdependence and Team Management, for Each Data Collection. (N=55 except where noted.)

Joint Management Responsibility:	T2	T3	T4	T5
x Diffusion of Scheduling Interdependence	.07	.14	.21	.27*
x Diffusion of Instructional Interdependence	.25*	.37**	.26*	.19
x Intensity of Instructional Interdependence (N=26)	-.09	.05	-.27	.00

Significance key: * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

Table 8. Regression of Team Management on Task Interdependence.

Criterion	Time	Predictor	Time	Beta	Cumulative R^2	F	df
Joint Management Responsibility	T4	Joint Management Responsibility	T2	.40	.22	13.26**	1/47
		Diffusion of Instructional Interdependence	T2	.25	.28	3.83	1/46
Joint Management Responsibility	T4	Joint Management Responsibility	T2	.35	.14	3.26	1/20
		Intensity of Instructional Interdependence	T2	-.28	.22	1.91	1/19

Significance key: ** $p \leq .01$

This incongruity adds to the suggestion of divergence of ambitious task collaboration from the general pattern of relationships obtaining between the diffusion of task interdependence and coordinative behavior.

The fact that the sole noteworthy relationships occurred between T2 and T4 is further damaging to the hypothesis that joint management responsibility would increase in response to task interdependence. Such an increase would have been expected within a year, not across years. The inference we draw is that the cross-sectional relationships observed between diffusion of instructional interdependence and joint management responsibility reflect a general commitment to the IGE/MUS innovation rather than a causal effect of one variable on the other. If this is true, then the innovation seems to hold together better at the unit level than at the school level; Packard and Jovick report puzzling negative relationships between the school-level indices of the same constructs during the first year of implementation, although the relationship becomes positive by T5. They were able to draw no clear picture of effects between these two variables, nor does the present paper. There were no significant lagged effects in either direction.*

*There is some evidence of the effects of communication on team management, however; see Appendix C.

IV. Conclusion.

Hypotheses were offered on the effects of task interdependence on communication and team management. Only the first hypothesis, effects on communication, has received support. The support, moreover, is weak and limited to the second year of implementation. No effects were found during the first year, although cross-sectional correlations (Table 3) showed that there were associations between task interdependence and communication measures during that period. Table 9 summarizes the information contained in Tables 3 and 4 concerning the relationship

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Table 9 About Here

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between scheduling interdependence and communication. These appear to be the data's answer to Hypothesis 1, and it must be noted that this answer minimizes the impact of the main thrust of IGE/MUS--instructional interdependence--on teacher interaction.

It is possible, however, that the unit measures of instructional interdependence employed are not well chosen to assess this phenomenon's effect on communication. As in Table 1, instructional interdependence is a much less diffuse phenomenon than classroom communication; it is not likely that variation in task arrangements affecting a small subset of unit members would predict departures from total inclusiveness in communication among unit members. Scheduling interdependence, which more often attains complete interconnection of unit members, is a better candidate as a predictor of diffusion of classroom communication, and so the data confirm. Returning to instructional interdependence, one

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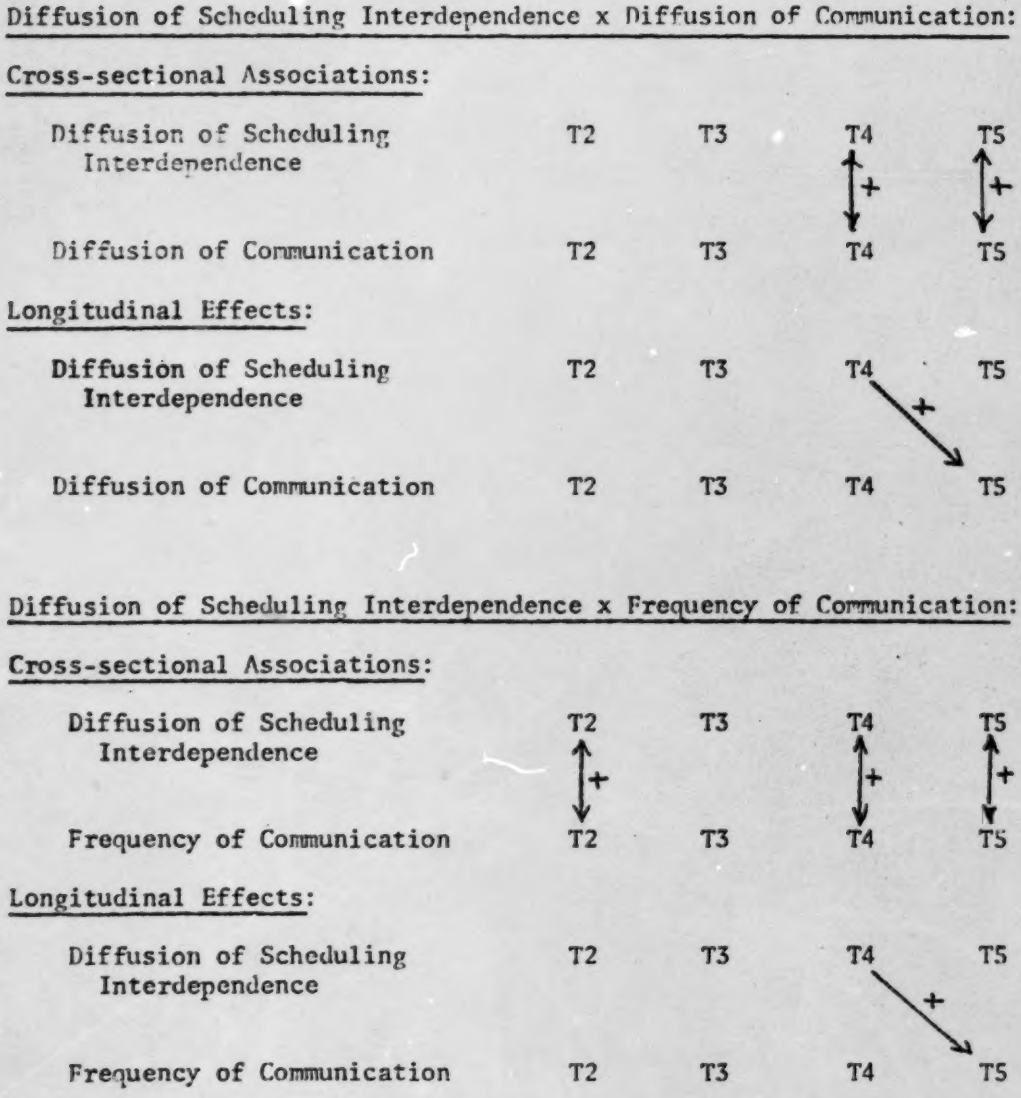
[9]Table 9 appears on page 33.

Table 9. Summary Display of Effects Relevant to Hypothesis 1: Scheduling Interdependence and Classroom Communication.



would look more for the intensity of the instructional interdependence present in a unit to boost the frequency of communication among teachers involved and thus, indirectly, affect the unit mean frequency of communication likewise. Table 3 showed that this was generally the case, although the low N of 26 deprived the correlations of statistical significance.

The effect of task interdependence on team management (Hypothesis 2) proved to be insignificant. We were especially surprised to discover that even the cross-sectional correlations indicated that whatever relationships might be present were largely restricted to instructional interdependence rather than scheduling interdependence. The logic presented above concerning the greater likelihood of scheduling interdependence affecting unit-wide characteristics--of which team management surely is one--is challenged here. We suggested that instructional interdependence and team management may both reflect a common underlying commitment to IGE/MUS, which produces the (spurious) cross-sectional correlations. This, however, is a matter of speculation at present.*

We have attempted to link together a number of provocative findings concerning the divergence of intense instructional interdependence from patterns suggested by measures of the diffusion of interdependence. The intensity of instructional interdependence is negatively related to the diffusion of interdependence and--occasionally--to both diffusion of communication and team management also. There are hints of negative lagged effects in both the latter cases. This evidence prompts us to suggest that really ambitious task collaboration is characteristic of distinct pairs of teachers rather than the wider unit membership, although mild

*Analysis is continuing regarding possible contextual effects of schoolwide collegial decision-making on these relationships. No clear pattern has emerged yet. Evidence is presented in Appendix C that communication affects team management, although no interaction effects of communication and task interdepence on team management have been discovered.

instructional interdependence may become diffused widely throughout a unit. Moreover, intensely-interdependent pairs may well tend to "secede" in some ways from the unit. If one imagines the degree of mutual co-orientation and energy expenditure generated in such pairs, one is not surprised that there may be little interest in or tolerance for involvement in wider communication networks and team management responsibilities. It should be remembered that earlier studies of teaming focused on groups defined by existing collaboration or by architectural constraints; here we are concerned with groups perhaps defined by administrative fiat and including virtually the whole school faculty. There may be a tension between spontaneous "teaming" of the former sort and the official creation of units.

In sum, unit formation and collaborative teaching admit of many shades of distinction. It is necessary to specify the kind and extent of teaching collaboration before predicting effects of its occurrence on a broader range of collegial phenomena. We have found scattered evidence that some kinds of collaboration do affect collegial interaction rather than an uninterpretable web of reciprocal relationships among these variables. The fact remains, however, that cross-sectional associations outnumber longitudinal effects, and therefore we have not clarified all the causal relations in the study. A different schedule of data collections might well have revealed other effects--possibly reciprocal ones--masked in this analysis. Nevertheless, the MITT study has allowed more subtle analyses of these problems than heretofore and provides a set of lessons which must be absorbed before mounting a more-fine-grained (and, presumably, even more expensive) inquiry into these important processes of teacher collaboration.

APPENDICES

Appendix A. Distribution of unit scores on diffusion of task interdependence and communication and team management, for each data collection.

Appendix B. Auto-correlations among different data collections for measures of task interdependence, classroom communication, and team management.

Appendix C. Team management and communication.

References

Appendix A: Distribution of Unit Scores on Diffusion of Task Interdependence and Communication and Team Management, for Each Data Collection

(Figures are percentages falling in each category.)

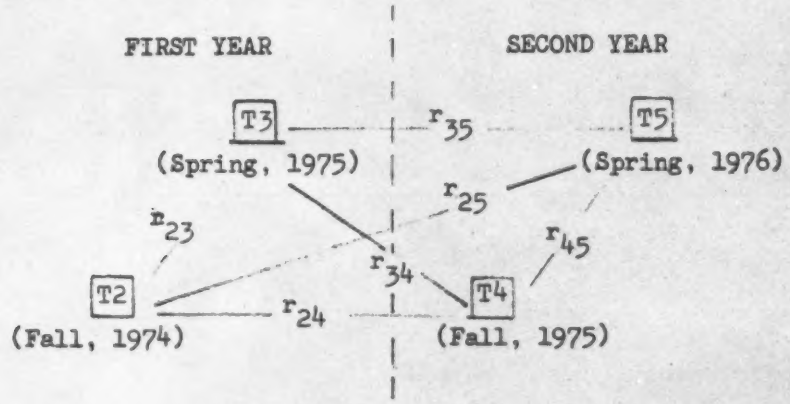
N=55

Task Interdependence		T2	T3	T4	T5
Diffusion of Scheduling Interdependence	Completely Interconnected	38	38	47	49
	Partially Interconnected	40	42	36	40
	Not at All Interconnected	22	20	17	11
Diffusion of Instructional Interdependence	Completely Interconnected	11	9	6	9
	Partially Interconnected	35	38	39	34
	Not at All Interconnected	54	53	55	57
Diffusion of Classroom Communication	Completely Interconnected	74	67	67	64
	Partially Interconnected	26	33	33	36
	Not at All Interconnected	0	0	0	0
Joint Management Responsibility (Midpoint of each category range is a "pure" response: 0,.2,.4,.6)	.51 - .70	4	12	6	8
	.31 - .50	30	46	24	31
	.11 - .30	46	32	47	33
	.00 - .10	20	10	23	29
	Mode	.20	.40	.00	.00

Appendix B. Auto-correlations among Different Data Collections for Measures of Task Interdependence, Classroom Communication, and Team Management.

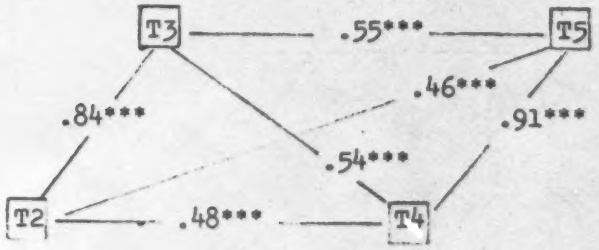
(N=55 except where noted)

GENERAL FORMAT:

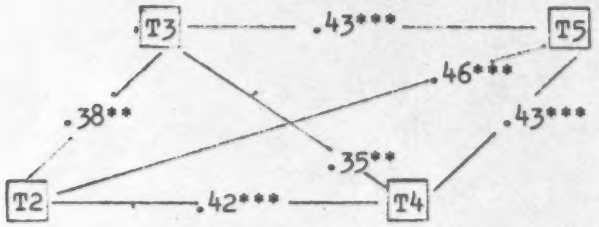


TASK INTERDEPENDENCE

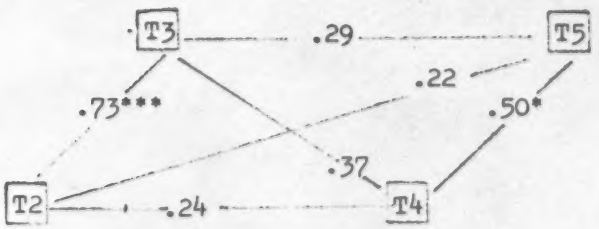
Diffusion of Scheduling Interdependence



Diffusion of Instructional Interdependence

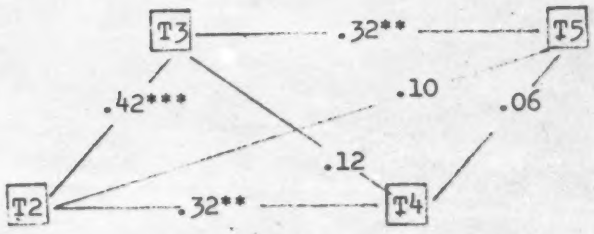


Intensity of Instructional Interdependence (N=26)

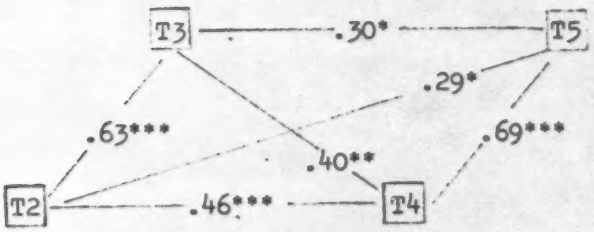


CLASSROOM COMMUNICATION

Diffusion of Communication

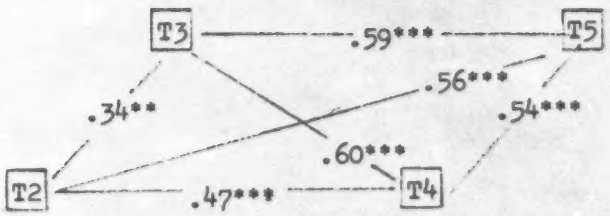


Frequency of Communication



TEAM MANAGEMENT

Joint Management Responsibility



Significance key: * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

Appendix C. Team Management and Communication.

We have investigated the effects of task interdependence on communication and team management. A third hypothesis can be entertained: communication should increase as a function of team management. This hypothesis was not deemed as sensitive to the longitudinal analysis possibilities of the present data set as the two hypotheses tested in the main text, because effects of team management on communication, if not tautological, should be virtually instantaneous. Certainly, the joint exercise of management responsibility implies communication. However, the data were probed for cross-sectional relationships, with the results shown in Table C-1.

Table C-1. Cross-sectional Correlations Between Team Management and Communication, for Each Data Collection. N=55.

Joint Management Responsibility:	T2	T3	T4	T5
x Diffusion of Communication	.20	.47***	.36**	.22
x Frequency of Communication	.18	.17	.20	.27*

Significance key: * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

Actually, the relationships between these two variables are surprisingly weak. Evidently, classroom communication levels are determined by forces other than team management arrangements. And, in fact, there are no significant longitudinal effects of team management on classroom communication.

We also tested, however, for reciprocal effects of communication on team management, and this proved more fruitful. In fact, we observe here

the sole significant lagged effect during the first year of implementation. The diffusion of classroom communication at T2 has a positive impact on joint management responsibility at T3. Here is a possible explanation for the increase in joint management responsibility at T3 noted in Table 5. Apparently, units beginning the first year of implementation with inclusive communication networks are more likely to increase the scope of team management during the course of that year than are units with gaps in their communication network. Moreover, that boost seems to have an enduring impact. The one other significant effect was produced by the regression of T5 joint management responsibility on T2 diffusion of communication. Subsequent investigation revealed that this effect was mediated by T3 joint management responsibility--which, as we have just seen, increased as a function of T2 diffusion of communication. When this mediating variable was added to the regression equation, the direct effect of T2 diffusion of communication on T5 joint management responsibility disappeared. Table C-2, therefore, shows only the T2-to-T3 effect.

Table C-2. Regression of Team Management on Classroom Communication. N=55.

Criterion	Time	Predictor	Time	Beta	Cumulative R^2	F	df
Joint Management Responsibility	T3	Joint Management Responsibility	T2	.27	.12	6.27*	1/46
		Diffusion of Classroom Communication	T2	.32	.21	5.13*	1/45

Significance key: * $p \leq .05$

Thus, the relationship between team management and classroom communication is not only much less obvious than originally thought, but the causal flow is apparently opposite to the direction predicted. Although task interdependence, despite its internal heterogeneity, can claim priority as a cause of collegial interaction, it would seem that communication affects rather than is affected by team management. To repeat the conclusion of the main text, we have the feeling that the web of causal relations among these phenomena is of a finer mesh than even the subtleties of the MITT data set allow us to investigate satisfactorily.

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